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# FUTURE OF THE UK AND SCOTLAND

## The 'disconnect' between science and innovation within Scotland

Omid Omidvar, Joyce Tait and David Wield

*This policy brief is one of a series describing Innogen's research on the implications of independence for science and innovation in Scotland through the lens of changes in the wider innovation eco-system.*

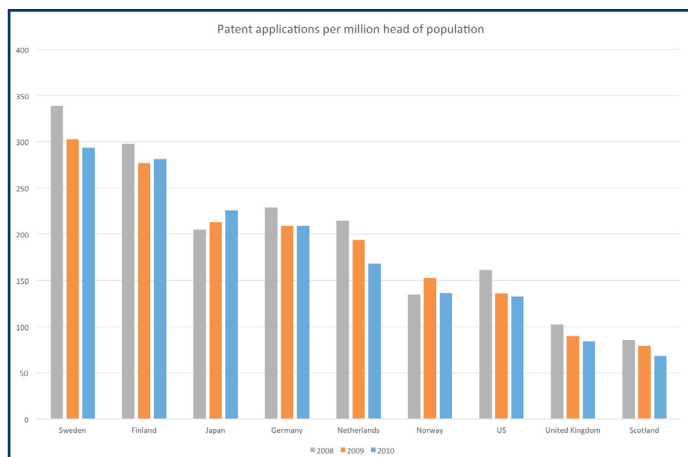
### THE SCIENCE BASE IN SCOTLAND

The science base in Scotland has traditionally been strong, with world-leading universities driving the development of science – a fact that is shown in a number of studies (Scottish Science Advisory Council, 2009)<sup>1</sup>. The contribution of the science community has been significant in the past and current trends suggest that Scotland is geared to produce high-quality research in the future. Particularly significant is the contribution of scientists to the fields of agriculture, biological sciences, biochemistry, and immunology, where Scotland stands amongst the top five countries in the world, in terms of publication numbers per million head of population.

However, data suggests that this excellence in the science base has not



translated well into innovation. One of various indicators of poor translation is the patent record, which is relatively poor for Scotland (Figure 1). For instance, with 68.5 patents per million head



of population, Scotland generates four times fewer patents than Finland (281.5 patents per million head), significantly fewer than countries like Sweden, Japan, Germany and US (294, 226,

209, and 132.5 patents per million, respectively) and even fewer than the UK average (with 84 patents per million)<sup>2</sup>.

### SCOTTISH SCIENCE AND INDUSTRIAL DYNAMICS

As part of the research project, Scottish Science and Industrial Dynamics, funded by the Economic and Social Research Council (ESRC) as part of its Future of the UK and Scotland programme, Innogen analysed the weak relationship between science and innovation in Scotland. In addition to Innogen's research, the project included a workshop and a series of interviews with academics, policy makers and industry practitioners. As a result, a number of possible reasons were found for this weak relationship

<sup>1</sup> SSAC. (2009). Business R&D in Scotland – a Missing Link. Edinburgh: Scottish Science Advisory Council.

<sup>2</sup> OECD statistics – 2010 values

between science and innovation.

## HUMAN CAPITAL

First, research suggests that Scotland does not exploit its human capital as much as it potentially could. Scotland has 36.9 percent of its labour force with tertiary education, which compares well with other innovative countries (e.g., 35.3 percent in Finland, 30.4 percent in Sweden and 25 percent in Germany). However, while Scotland fares well in employment in knowledge-intensive services (42.8 percent of its total employment), in comparison to other countries (e.g., Finland with 41.1 percent and Germany with 35.3 percent), the highly educated labour force has not been as significantly employed in High and Medium-High Technology Manufacturing sectors. Scotland's 3.86 percent employment in High and Medium-High Manufacturing is considerably lower than other innovative countries (e.g., Germany with 10.9 percent, Finland with 7 percent, and Norway with 4.3 percent)<sup>3</sup>. In addition, there is evidence that Scotland has been notably weak in cultivating commercial and managerial skills, which are critical for developing innovations out of basic science (Plany, 2010)<sup>4</sup>. As one informant argued: "There is an issue with skills for growth and there is lack of leadership, finance, operation and organisational skills," which has resulted in start-ups "filled with entrepreneurs with technical

knowledge, but lacking commercial experience."

There is a dearth of senior managers who are capable of running large-scale corporations and who can start big initiatives, and there are not many large companies in Scotland that can attract or retain experienced managers. This results in a "chicken and egg" problem; the limited number of large companies in Scotland and the lack of high-level managerial skills are related. Spinouts and start-ups tend to leave Scotland and find a base elsewhere once their businesses start to grow. Lack of these large companies means that there are not enough 'role models' for SMEs to emulate which, in turn, means that more experienced entrepreneurs leave Scotland, creating a hole in the entrepreneurial skills base.

## R&D FUNDING AND EXPENDITURE

Another problem relates to the level of funding for R&D. Scotland's percentage of total R&D expenditures to GDP (1.7 percent) is considerably lower than other innovative countries (e.g., 3.9 percent in Finland, 3.3 percent in Japan and 2.8 percent in Germany – see Figure 2), not to ignore other regions within the UK (e.g., East and South England with 4.3 percent and East of England with

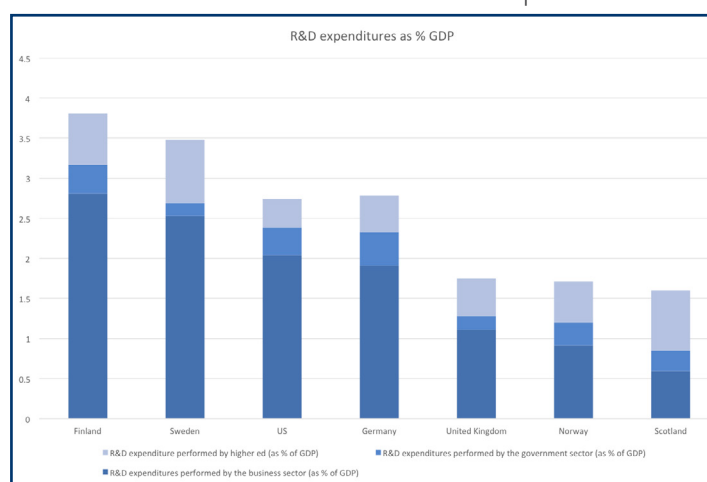
of R&D expenditure to GDP performed in Scottish higher education (0.81 percent) is higher than the UK average (0.52 percent) and is akin to other benchmarked countries (0.9 percent in Sweden, 0.72 percent in Finland and 0.56 percent in Norway). R&D expenditures

**"There is an issue with skills for growth and there is a lack of leadership, finance, operation and organisational skills..."**

performed by businesses in Scotland (0.59 percent of GDP) is considerably less than other innovative countries or

other innovative regions within the UK, and indeed is slightly less the UK average (1.1 percent)<sup>6</sup>. Thus, business sector's lower contribution to R&D expenditure is responsible for the overall lower percentage of R&D expenditures to GDP in Scotland. The low levels of Business R&D investment calls for adopting measures that can potentially encourage R&D investment in Scotland (e.g. through R&D tax credits, etc.), although there is no conclusive evidence that policy measures encouraging higher R&D expenditure yield innovation (cf. Köhler et al. 2012)<sup>7</sup>.

The risk capital market is one source for business R&D expenditures. A recent report by Harris and Mason (2012) suggests that the risk capital market in Scotland has performed relatively well in the deal band size between £100k and £2 million. For instance, in 2011, £12.8m worth of angel investment and £14.4m of VC funds were channelled into businesses in this range (Mason and Botelho, 2013)<sup>8</sup>. Over the recent years, the business angel investment model in Scotland has matured and has contributed to the growth of investment by aggregating the money of high-income individuals who are less knowledgeable about the markets. However, the situation is not so good with larger venture capital investments (over £2 million). In 2009, 2010 and



<sup>6</sup> OECD statistics – 2009 values

<sup>7</sup> Köhler, C.; Laredo, P.; Rammer, C. The Impact and Effectiveness of Fiscal Incentives for R&D.

Nesta Working Paper No. 12/01:

[http://www.innovation-policy.org.uk/share/01\\_The%20Impact%20and%20Effectiveness%20of%20Fiscal%20Incentives%20for%20R&D.pdf](http://www.innovation-policy.org.uk/share/01_The%20Impact%20and%20Effectiveness%20of%20Fiscal%20Incentives%20for%20R&D.pdf)

<sup>8</sup> Mason, C.; Botelho, T. (2013) The Transformation of the Business Angel Market: Evidence from Scotland

2011, only 11, 15, and 10 deals over £2 million, respectively, were reached and most investors do not invest on a regular basis. These figures suggest that Scotland fares worse than other UK regions in securing large VC funds. The downside of the limited level of VC support is that it is hard for angel investments to lead into 'companies of scale'. As one of the interviewees articulated: "Penetrating global markets needs VC investment which is absent in Scotland."

The small amount of available VC investment means that Scotland needs to adopt a more aggressive strategy to attract non-UK VCs, and especially to engage with investors that specialise in sectors where Scotland excels. This can be achieved through making connections with foreign venture capitalists. In the presence of increased financial uncertainties on venture capital markets, firms may require consideration of alternative funding models and/or strategising effective management of demand markets, which highlights the role of accelerators and soft funding methods, such as crowdfunding, lean start-ups and bootstrapping, become more important (Harris and Mason, 2012)<sup>9</sup>.

## ACADEMIC - INDUSTRY COLLABORATION

The ability to collaborate across organisational and disciplinary

boundaries is known to contribute to innovation. However, research suggests that Scotland was, in the past, not particularly strong in forming and harnessing collaborations (Levie, 2012)<sup>10</sup>. For example, lack of collaboration between companies and academia can decrease the capacity of companies

**“The independence debate might provide an opportunity to move from the traditional argument in Scotland ‘science is good, innovation is weak’ towards a more integrated innovation systems approach.”**

to acquire and absorb knowledge from academia and each other. According to our informants, the UK research evaluation exercise (RAE/REF) was seen

as weakening the relationship between academia and industry because of its emphasis on academic publications rather than engagement with industry, which leaves little incentive for academics to collaborate closely with industry. Moreover, Scotland has not been very successful in establishing lucrative clusters, which are critical in creating critical mass and enabling innovations. Complementing the current REF system with incentives for academics to collaborate with industry, encouraging the formation of clusters and meta-clusters within Scotland, and facilitating internationalisation of Scottish companies are potential paths for reinforcing the innovation base within Scotland.

The evidence on academic-industry collaboration is only one part of the picture. The independence debate might provide an opportunity to move from the traditional argument that in Scotland 'science is good, innovation is weak' towards a more integrated innovation systems approach. The traditional 'science good, innovation weak' approach often leads to a policy debate based on how to bridge the science-innovation gap and thus how to translate from science to commercialisation.

An alternative policy approach that has received much less attention in Scottish policy circles is how to go beyond starting with 'good science' and instead look at existing and potential economic activity in Scotland so as to improve the innovative potential across the broadest range of industrial sectors - an innovation systems approach. One recent initiative has been based in the Scottish food and drink sector (Interface Food & Drink). This began from the needs of a key and internationally successful industry in Scotland, rather than from what is good about Scottish science.

An innovation systems approach would build on specific application areas, like food and drink, to support the diverse capacities and linkages needed to strengthen the connections between industry and Scotland's science, business and innovation base. Such an approach would necessarily involve an integrated raft of activities and institutions focused on existing and emerging industries and services.

<sup>9</sup> Harrison, R. Mason, C. (2012) The Risk Capital Market in Scotland 2009 – 2011

<sup>10</sup> Levie, J. (2012). Global Entrepreneurship Monitor: Scotland. Glasgow: Global Entrepreneurship Monitor.

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